Astronomy

ES-2 The student will demonstrate an understanding of the structure and properties of the universe.

ES-2.4 Explain the formation of elements that results from nuclear fusion occurring within stars or supernova explosions.
Taxonomy level: 2.7-B Understand Conceptual Knowledge

Previous/future knowledge: The formation of elements as a result of nuclear fusion within stars or exploding supernovas is a new concept for this course; it has not been presented in any previous grades.

It is essential for students to have a basic understanding of the process of nuclear fusion. The temperature inside a star governs that rate of nuclear fusion.

- Stars in the main sequence all produce energy by fusing hydrogen into helium as the Sun does.
- Stars outside the main sequence may fuse different elements in their cores or may not undergo fusion at all.
- Once a star's core has been converted from hydrogen to helium, if the temperature is high enough, the helium may fuse to form carbon. This is the second nuclear fusion reaction phase of a star.
- At even higher temperatures other elements such as oxygen, neon, magnesium and silicon may form. Stars can produce few elements heavier than iron.
- When the outer portion of a star is blown off in a massive explosion, known as a supernova, elements heavier than iron are created and enrich the universe.
- The star's element composition is determined by how many fusion reaction phases it has gone through.

It is not essential for students to diagram the fusion process or write nuclear fusion equations. The comparison of nuclear fission and fusion is not part of this indicator.

Assessment Guidelines:
The objective of this indicator is to *explain* the formation of elements within stars as a result of nuclear fusion; therefore, the primary focus of assessment should be to construct cause and effect models about the formation of elements based on the fusion reaction element involved.
In addition to *explain* appropriate assessments may require students to:

- *summarize* the process of nuclear fusion;
- *infer* how heavier elements could result from a supernova explosion;
- *recall* elements formed from nuclear fusion in stars; or
- *identify* the elements formed in the first two fusion reaction phases.